

Final Project Report

Exploring Solar Energy Applications in Rural Virginia

***Applying Renewable Energy Project Screening,
Analysis Tools and Decision Support Software***

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Context

Whether due to worries of rising energy prices, climate change, or energy security issues, many citizens are concerned that our nation has become too dependent on foreign sources of petroleum and are troubled by the impacts that this dependence has created. In response to these issues, the federal government signed into law the *Renewable Fuels, Consumer Protection, and Energy Efficiency Act of 2007*. This act seeks to move the United States toward greater energy independence and security and promote the production of renewable fuels. Additionally, the commonwealth announced in the *2010 Virginia Energy Plan* a target of making Virginia the energy capital of the east coast by increasing in-state production of energy by 20 percent over the next 10 years. These policies are indicative of a broader interest to sustainably increase our energy independence while spurring economic growth.

According to the Virginia Department of Agriculture and Consumer Services “agriculture is Virginia’s largest industry by far, with nothing else coming a close second. The industry has an economic impact of \$55 billion annually and provides more than 357,000 jobs in the Commonwealth. The industries of agriculture and forestry together have a total economic impact of \$79 billion and provide more than 501,000 jobs in the Commonwealth. Every job in agriculture and forestry supports 1.5 jobs elsewhere in the Virginia economy.” There are approximately 47, 383 farms in Virginia and in 2007, Virginia farmers spent \$156M in fuel and \$52M in electricity and other utilities. Renewable energy systems present a unique opportunity for farmers to lower production costs, increase profit, and reduce exposure to volatile fossil fuel markets. However, adoption rates remain low. In fact, in 2009 only 83 Virginia farms utilized solar electric or solar thermal renewable energy systems. Of the thousands of farms that utilize these systems nationwide, only 1% are located in Virginia, representing less than 0.18% of all Virginia farms.

Objective

This effort sought to examine cost-effective opportunities for expanding on-farm solar energy use, implementation, and development in Virginia.

Energy Project Assessment Tools

Conduct energy project assessment trainings in order to introduce and enhance analysis skills and tools to lay audiences and service providers to help them better and more efficiently discern the most viable project opportunities based on their objectives and constraints. For example, the USDA REAP program is one of the primary grant funding options for renewable energy projects in Virginia. However, a REAP renewable energy project, depending on total project cost, can require a comprehensive feasibility study which can be quite expensive. USDA does also offer a REAP grant to conduct feasibility studies. REAP grants are increasingly competitive with dwindling federal resources and increasing numbers of applicants. Prior to investing in a robust feasibility study, or the time to assemble and wait on a REAP application, savvy renewable energy project developers must first “crunch the numbers” to determine if the project appears to satisfy their investment criteria for economic efficiency. Too often, this step is done with overreliance upon vendor data and often using only the rosier of assumptions. When in reality what is required is an impartial technical, financial, and sensitivity analysis to

identify overall project feasibility. Fortunately, a variety of third-party vetted project analysis software exists. However, its use is fairly limited to many projects in Virginia. These screening tools can help identify worthwhile projects and target very limited resources to the most promising of projects. Additionally, for smaller projects the screening tools themselves can often suffice in lieu of a feasibility study conducted by a professional engineer.

The project team organized six introductory workshops throughout Virginia providing participants a hands-on opportunity to work with RETScreen Clean Energy Project Analysis Software. These sessions were held in Hampton, Alexandria, Richmond, Shenandoah Valley, Roanoke, and Danville. The sessions featured international RETScreen training expert Michael Ross who himself developed many of the training modules for this program developed by Natural Resources Canada. Eighty-five participants registered for these daylong technical sessions. Based on participant feedback, a future and more in depth 2 ½ day RETScreen training has been scheduled for summer 2014. In addition to the RETScreen content, the sessions also included brief presentations on anaerobic digestion, community energy plans, lean manufacturing, solar thermal applications, green roofs among other themes presented by Virginia Tech and Virginia Cooperative Extension faculty to provide a Virginia context, and contact, to the training, as well as highlight the range of energy-related projects and applications in the region. Much of the content from these sessions is posted on the workshop webpage at this [link](#).

Educational Demonstrations

Several opportunities for small hands-on educational demonstrations to feature different solar energy conversion technologies were explored throughout Virginia. In the end, these efforts identified the following project opportunities:

1. Utility Interactive Solar Photovoltaic System at 4H Camp

This project relates to an approximately 1.08 kW net-metered photovoltaic array for the Northern Virginia 4H Camp and Conference Center located in Front Royal, VA. This facility receives approximately five thousand visitors each year, many during the height of the 4H summer camping season. As part of the educational programming, all visitors will be able to view the solar PV array on the roof and see its performance via an on-site monitoring television as well as remotely via the Internet.

2. On-farm Utility Interactive Solar Photovoltaics

This demonstration project leverages the presence of an existing on-farm solar energy project by adding remote monitoring capabilities to the installation. The system performance monitoring unit will enable a broader audience to understand the costs and performance of the project. This particular installation will also feature micro-inverters. The monitoring will enable exploration of the impact monetization of solar renewable energy credits (SRECs) has on small-scale projects in Virginia.

3. Solar Thermal Applications for an Aquaponic System

Virginia Cooperative Extension is a component of both Virginia Tech and Virginia State University. Virginia State University is located in Petersburg, VA and their extension faculty conduct integrated research and extension programming in several key areas, including aquaculture production. Aquaculture systems, or fish farming, are intensive production systems which can use significant amounts of energy for water heating. The term aquaponics refers to the integration of fish farming with hydroponics, or various edible plants and fruits grown in greenhouses in soilless media often using the waste products generated by the fish as a nutrient source. Virginia State University manages the Randolph Farm which also serves as a research and demonstration area for the university's aquaponic system. The facility receives approximately four thousand visitors each year through school visits and farmer field days. The solar thermal demonstration consists of two 4'x14' solar thermal collectors manufactured by Sunquest in Newton, NC. These Solar Rating and Certification Corporation (SRCC) rated collectors will serve to offset a portion of the electrical and propane-based heating currently used to maintain adequate water temperatures for fish growth and survival during the cooler months. Furthermore, the units will also serve as a demonstration to the many visitors frequenting the facility regarding appropriate and cost-effective solar energy applications.

4. Hands-on Energy Learning Lab

This educational outreach demonstration project serves as a mobile learning lab, currently featuring solar energy conversion technologies. The first iteration of the unit made its debut, in collaboration with local USDA sub-agencies, at the Rockingham County Fair in Harrisonburg, VA in August 2013. The Rockingham County Fair has been designated the "Top Agricultural Fair in North America" by the International Association of Fairs and Expositions. The 2013 Rockingham County Fair set a new attendance record with 88,885 people visiting the fair, with many of these participants engaging the educational trailer. Its second debut is scheduled for the county fair in 2014, and will now feature a solar thermal collector, solar powered water pumping unit, among other modules. Plans are underway to expand the use of this unit in collaboration with other educational outreach partners. The educational unit has been developed in collaboration with the Valley Conservation Council, Madison Steel, Sunquest, and Azimuth Solar Training.

Educational Workshops & Resources

In addition to the six RETScreen workshops, two solar-focused educational workshops were completed. The first session was held in Harrisonburg, VA



Solar Energy Workshop in Front Royal, VA held Saturday, May 17, 2014

and focused on solar hot water applications. The second session was held in Front Royal, VA and focused on solar photovoltaic applications. Thirty-nine participants registered for these Saturday workshops. Virginia Clean Cities was also collaborator on the solar PV workshop.

A [recent report from the Pew Research Center](#) found that about 78% of online adults watch streaming video content (e.g., YouTube, etc.) and that about half is educational video content (e.g., do it yourself instruction, etc.). In response to this emerging trend, summary educational videos from these workshops were developed and posted online, one focusing on solar hot water and the other on solar photovoltaics. The production of the videos was also supported with funds from the Virginia Tobacco Indemnification and Revitalization Commission as a component to Virginia Cooperative Extension's *Agricultural Energy Efficiency Initiative*. These videos have become useful tools for clientele that are interested in these technologies but who were unable to attend an in-person workshop during the project window.

Educational Videos and Useful Links

- Solar PV system viewer at the tobacco farm:
http://www.energyinfo.bse.vt.edu/?page_id=220
- Educational Videos
 - Solar PV - http://www.aeei.bse.vt.edu/?page_id=151
 - Solar Thermal - http://www.aeei.bse.vt.edu/?page_id=169
 - RETScreen
 - Videos - http://www.energyinfo.bse.vt.edu/?page_id=67
 - Case Studies
 - http://www.aeei.bse.vt.edu/?page_id=184
 - <https://sites.google.com/site/agbyproductutilization/energy-efficiency-workshop-dairy-farms/home/retscreenworkshops>